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Linking Multifunctionality and Sustainability for Valuing Peri-Urban Farming: A Case Study in the Turin Metropolitan Area (Italy)

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Abstract: Agriculture plays a key role in managing the peri-urban landscapes in Europe, influencing their social, aesthetic and environmental functions. Considering the increase in urban population and land consumption in the last decades, sustainability in peri-urban areas is a priority. Farming multifunctionality is the integration of different functions and activities that produce beneficial effects on local economy, environment and society. Three research questions were explored: How is multifunctionality applied in peri-urban agroecosystems? How do we ensure sustainability in peri-urban agroecosystem? How could a bottom-up approach promote sustainable actions, strategies and policies? The Chieri Municipality (Turin Metropolitan Area, Italy) was chosen as representative case study. A trans-scalar approach from the farm to the municipality levels was adopted. The analysis of statistical data and farmers' interviews were performed. Multifunctionality for three main farm categories (crops and grasslands; vineyards and orchards; and horticulture) was explored using the following parameters: website presence, online selling, agritourism, didactic farms, nonagricultural activities, maintenance parks and gardens, renewable energy, and transformation. According to the different farm types, multifunctionality assumes different aspects covering specific sets of sustainability needs. We consider important to move from the farm level multifunctionality to the landscape level multifunctionality in order to provide all services at a territorial scale. As a result, the following perspectives and strategies were proposed: increasing rural farm networks and cooperation, promoting initiatives for valorizing the local food products, including farms in touristic and cultural networks, and involving farmers in social and didactic programs. In conclusion, this methodology could be applied for decision makers and planners for implementing a participatory approach in environmental-social and economic programs for peri-urban areas.

Keywords: participatory approach; interviews; farms; landscape planning; agroecosystem

1. Introduction

In recent decades, urban expansion has caused a great impact on the consumption of land and agricultural resources [1–4]. Peri-urban landscapes are areas where low-density residential settlements are intertwined with agricultural systems that have been modified and occasionally reduced by urbanization [5]. Further, according to Primdahl et al. (2013), peri-urban landscapes in Europe are dramatically decreasing and changing, with great implications for biodiversity, environment and cultural heritage [6]. In particular, the growth of cities occupied fertile soils and fragmented farms reducing the sustainability of the farming system.

Maintaining agricultural landscape's sustainability in peri-urban areas is a priority and a challenge, because it represents a major part of the cultural landscape in urbanized areas [7,8]. In this context, agriculture plays a key role in the landscape management by influencing the social, aesthetic and environmental functions of the urban metropolitan areas and supplies different services. According to Willemen et al. (2017), agricultural ecosystems are the main ecosystems in the anthropocene [9]. In contrast, many agricultural practices and the expansion of agricultural areas are a major threat to well-functioning, healthy ecosystems [10]. For the sustainable development of peri-urban agroecosystem, it is essential to find a methodology able to conjugate cultural, environmental and ecological values with economic and social needs [11]. In this context, according to Casini et al. (2012) developing models that integrate traditional and historical farming processes with nonmarket goods and services' evaluation is a priority challenge [12]. Moreover, O'Farrell and Anderson expressed the need to translate the theoretical role of ecosystem services for guiding multifunctional landscapes in urban and agricultural systems [13].

Selman (2009) evaluated the multifunctionality concept as a tool for the sustainable management of urban and rural landscapes. Multifunctionality is defined as the integration of different functions and activities to produce beneficial effects on local economy, environment and social objectives [14]. According to O'Farrell and Anderson, sustainable multifunctional landscapes integrate human production and land uses with ecological, environmental and landscape ecosystem functions [13].

For Ohe (2007) and Huang et al. (2015) combining multifunctionality in agriculture with farm diversification showed that multifunctionality provides several goods and services, selling commodities and many externalities [15,16]. Some externalities are considered positive, such as maintaining rural landscape features and creating employment in rural areas, while others, such as pollution and impoverishment of soil are negative [17]. Moreover, peri-urban farmers with their current management, produce intangible externalities that have positive effects, for example the preservation of the soil and the water, and the implementation of biodiversity quality. According to Ohe (2007), if farmers can successfully take an externality into the farm business or internalize it, multifunctionality will give them a chance to realize a new income source [15]. In fact, agricultural landscapes do not provide only private good-type commodities, but also a broad range of public good-type services, which constitute important socioeconomic assets for the development of rural areas [18]. In regards to this topic, Pinto-Correia et al. (2017) have confirmed that nowadays in Europe, there are more and more small farmers that interplay with internal and external relationships in rural areas, where new balances between food production and landscape are growing [19]. These authors have demonstrated that the transition from production to lifestyle farming can be considered the new management arrangements for small farms. In this context, in peri-urban areas, analyzing the propensity of different farm types towards multifunctionality is considered a priority for maintaining agricultural landscape' sustainability [20–22].

Agroecosystems are the source of the most essential services demanded by both urban and rural populations [23]. The concept of socioecological systems allows to understand the perception within the community of benefits from landscapes and the interventions in the landscape that are carried out to guarantee the best value of these benefits. This bottom-up approach turns out to be a great challenge that should be complemented by actions at the broader levels of the local landscape, which are fundamental for guiding the future development [24,25].

At the farm scale, the supply of goods and services in multifunctional agriculture is a direct result of agricultural activities [26].

Research Aim

In Italy, the multifunctionality is a strategic factor in agricultural and rural policies [20,21]. This approach focused on the positive relationship between farm and territorial development. Nowadays, the economic measures promoted by Rural Development Programs (RDPS) for 2014–2020, favored directly or indirectly the farmers for implementing their social, cultural, economic and

environmental activities. In addition, as explained by Zasada (2011), these areas with their multifunctionality and post-productive attitude, were able to improve the sustainability of cities and could provide multiple benefits, rural public goods and services [22].

The purpose of this paper is to elucidate the concepts of multifunctionality and sustainability relative to peri-urban farming preservation; the evaluation is extended to the case study in the Turin metropolitan area (Italy). The research proposed a methodological framework to analyze multifunctional character of peri-urban agroecosystems, applied in a case study area recently recognized by United Nations Educational Scientific and Cultural Organization (UNESCO) as Man and the Biosphere Programme (MAB) site. Launched in 1971, MAB is an intergovernmental scientific programme aimed to establish the scientific basis for the improvement of relationships between people and their surrounding environments. MAB combines natural, social, economics, and education sciences to improve human livelihoods and to safeguard natural and managed ecosystems, thus promoting innovative approaches to economic development that are socially and culturally appropriate, and environmentally sustainable [27]. By focusing on sites recognized within the World Network of Biosphere Reserves, the MAB Programme mainly strives to identify and assess the future changes and their effects resulting from human and natural activities and to analyze and evaluate the services provided by the agroecosystems. By contrast to rural sites, recognized by UNESCO as cultural heritage, for their historical, agricultural and landscape features, MAB sites are more complex systems [28]. Ensuring the sustainability is essential and should be considered a scientific challenge [29]. In peri-urban context, different agricultural farm types exist, characterized by different land uses, cultivation methods, products obtained, and farm management.

The present study was motivated by the need to understand if multifunctional practices, applied by peri-urban farmers, are linked to sustainability. In the study, three research questions were explored:

- How is multifunctionality applied in peri-urban agroecosystems?
- How to ensure the sustainability in peri-urban agroecosystem? How could a bottom-up approach promote sustainable actions strategies and policies?

2. Materials and Methods

2.1. Study Area

Since 2016, the eastern part of the Turin metropolitan area was recognized by UNESCO as a MAB site. This site, named “The Collina Po Biosphere Reserve”, covers the Turin stretch of the Po River with its main tributaries and the Collina Torinese hillside. The Po River is the main reservoir of biodiversity in the Turin plain, due to the numerous wetlands along its course. Its physical and geological characteristics have led to the formation of numerous gravelly shores, oxbows and riparian woods that host a variety of faunal and botanical species. These natural features are of particular value to the densely populated local environment. “The Collina Po Biosphere Reserve” includes 85 municipalities, with about 1.5 million of inhabitants. As reported by MAB, this area has high population pressure, and is characterized by important habitats and historical-architectural features. A system of protected areas has been established in order to improve an urban area, and therefore also to provide recreational and outdoor opportunities to its over two million citizens and to the tourists visiting it [28]. Moreover, the buffer zone and transition area contain eight Savoy residences belonging to the Royal House of Savoy, which have been designated a UNESCO World Heritage Site (1997).

As far as this peri-urban area, we decided to select Chieri Municipality (45°00′37″ N, 7°49′16″ E) as case study. It is representative of the MAB landscape, mainly for the presence of different land uses linked to the plurality of natural and morphological features. Chieri Municipality (36,700 inhabitants in 2017) covers about 5400 ha with flat areas and hills ranging in altitude from 243 to 406 m above sea level. It is dominated by different agricultural systems combined with small-scale mosaics of other land uses resulting in a specific landscape character. In Figure 1, land uses of Chieri Municipality are

represented. The map shows the main land uses: arable lands, grasslands, arboriculture, woodlands, orchards and vineyards, vegetables and nurseries, urbanized areas and urban green spaces.

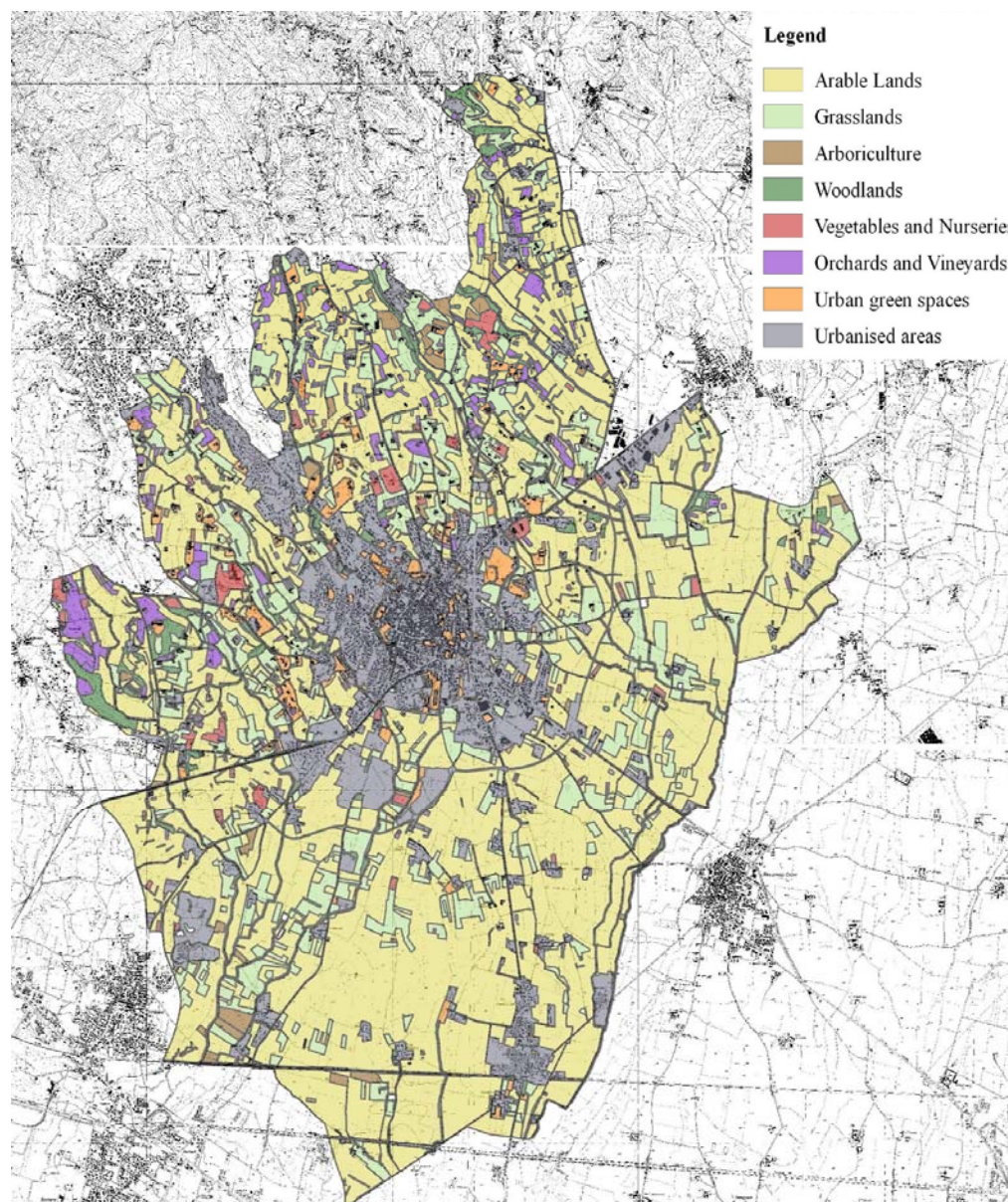


Figure 1. Land-use map of Chieri Municipality.

Arable lands (yellow) and urbanized areas (grey) occupy most of the analyzed territory. It is possible to notice how the northwest part of the map shows orchards and vineyards (violet), arboriculture (brown), vegetables and nurseries (red) and some woodlands (dark green) suggesting that this portion of the territory is morphologically more hilly than the rest of the territory. By contrast, the flat and irrigated areas are mainly characterized by grasslands (pale green) and arable lands (yellow).

For Chieri Municipality, the last agriculture census provided by Italian Institute of Statistics (ISTAT, Rome, Italy, 2010) reported a Utilized Agricultural Area (UAA) of 5018 ha [30]. The Statistical Census of Agriculture in Italy (ISTAT, Rome, Italy) is performed every ten years through a deep interview to all farmers legally recognized in each municipality. In order to describe the structural and economic situation of each farm, several data are collected. The rural mosaic is a nonspecialized and fragmented

farm pattern of different cultivations practiced. Regarding UAA, the main crop productions were classified in five categories: cereals (54%), permanent grassland (39%), arboriculture and woods (4%), vegetables, flowers and nurseries (2%), and fruit crops (1%). In Chieri Municipality, between 2000 and 2006, urbanization and population increased by 6% and 4%, respectively occupying the most fertile soils [31].

In 2010, there were 276 farms (ISTAT, Rome, Italy, 2010) [30]. By analyzing the main crop productions and the land used distribution, it is possible to group the total farms into three main categories: crops and grasslands (a), vineyards and orchards (b) and horticulture (C). Each farm type is characterized by a specific agroecosystem based on land use mosaic and morphological aspects:

- Crops and grassland (A) farms are located in the flat and irrigated area of Chieri. They produced mainly cereals and forage for the livestock activity;
- Vineyards and orchards (B) farms are located in the hilly area (line slope range 5–25%). They produce fruits (peach, apple, pear and cherry) and grapes (Freisa vineyard).
- Horticulture (C) farms are located both in the plain and hilly area, they produce ornamental plants, cut flowers and vegetables (tomatoes, salad, onion and garlic) cultivated in open fields and under tunnels or greenhouses.

In Figure 2, some photographs have been reported representing the three categories identified in the methodological framework and the related agroecosystems.



Figure 2. Representative farm types: Crops and grasslands (A); Vineyards and Orchards (B) and Horticulture (C) and related agroecosystems.

2.2. Methodological Framework

With the aim to address sustainability challenges of Mediterranean urban regions agroecosystems, Soulard et al. (2017) described agricultural-urban dynamics at three levels: farms, local community and urban region [7]. For each case study, totally six areas, the authors analyzed different parameters: ecosystems, agriculture and public policies. To investigate the peri-urban agroecosystem in this prospective, the present study proposes a methodological framework, in which a trans-scalar approach has been adopted (from the municipality to the farm scale). In Figure 3, the methodological scheme applied in the research is reported.

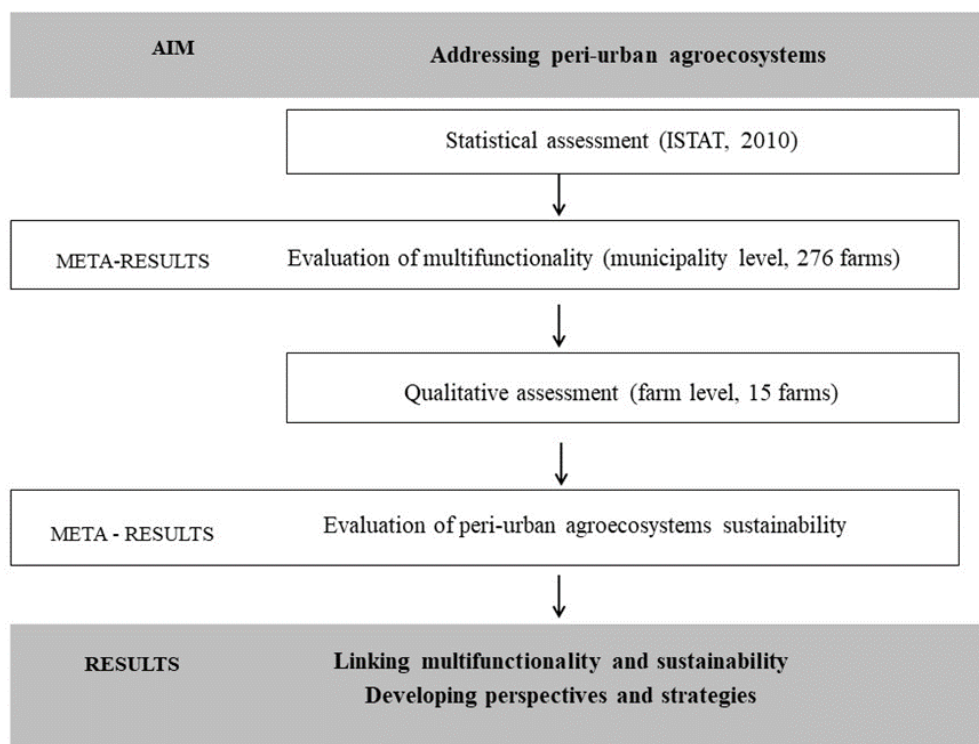


Figure 3. The methodological scheme applied in the research.

Firstly, with the aim to analyze the multifunctionality concept related to agricultural sector in Chieri (municipality scale), statistical data of the last agriculture census provided by Italian Institute of Statistics (ISTAT, Rome, Italy, 2010) were collected and analyzed. Statistical data concern all aspects of the agricultural sector in each Italian Municipality. The Italian Institute of Statistics collects the socioeconomic information of all farms through face-to-face interviews. Number of farms, farm surface, crops types and surfaces, type of owners (age and gender), number of workers and farm activities and many other indicators are used. Regarding multifunctionality, Casini et al. (2012) identified four types of multifunctional agriculture: opening to the national and international market (i); developing new farm activities (ii); integrating approach with environmental aims (iii); making local markets deeper (iv). According to the authors, with respect to the multifunctional theory, different parameters should be evaluated and directly translated into rural development models [12]. In this framework, we analyzed the 276 farms located in Chieri Municipality choosing, within the Agricultural Census database, the parameters related to multifunctionality: website presence, online selling, agritourism, didactic farms, work on behalf of third parties—non-agricultural activities, maintenance parks and gardens, renewable energy production facilities and the transformation of products. The presence or absence of these activities were listed for each farm.

Secondly, with the aim to analyze how the concept of multifunctionality is translated in a farm's activities (farm scale), qualitative research was carried out. Using a bottom-up approach, after several meetings with local stakeholders, such as technical public officials (Chieri Municipality, Turin, Italy) and farm advisors (farmer's trade association), 15 sample farms were identified. The farms were selected using these criteria: to be representative of the three peri-urban agroecosystems (land uses, and location), to follow different cultivation's methods (traditional, and organic), to have a potential multifunctional attitude. Also farmers' availability to be involved in the research was considered. In particular, nine crops and grasslands areas (A), three vineyards and orchards (B) and three horticulture farms (C) were analyzed. Figure 4 shows the location of the farms involved.

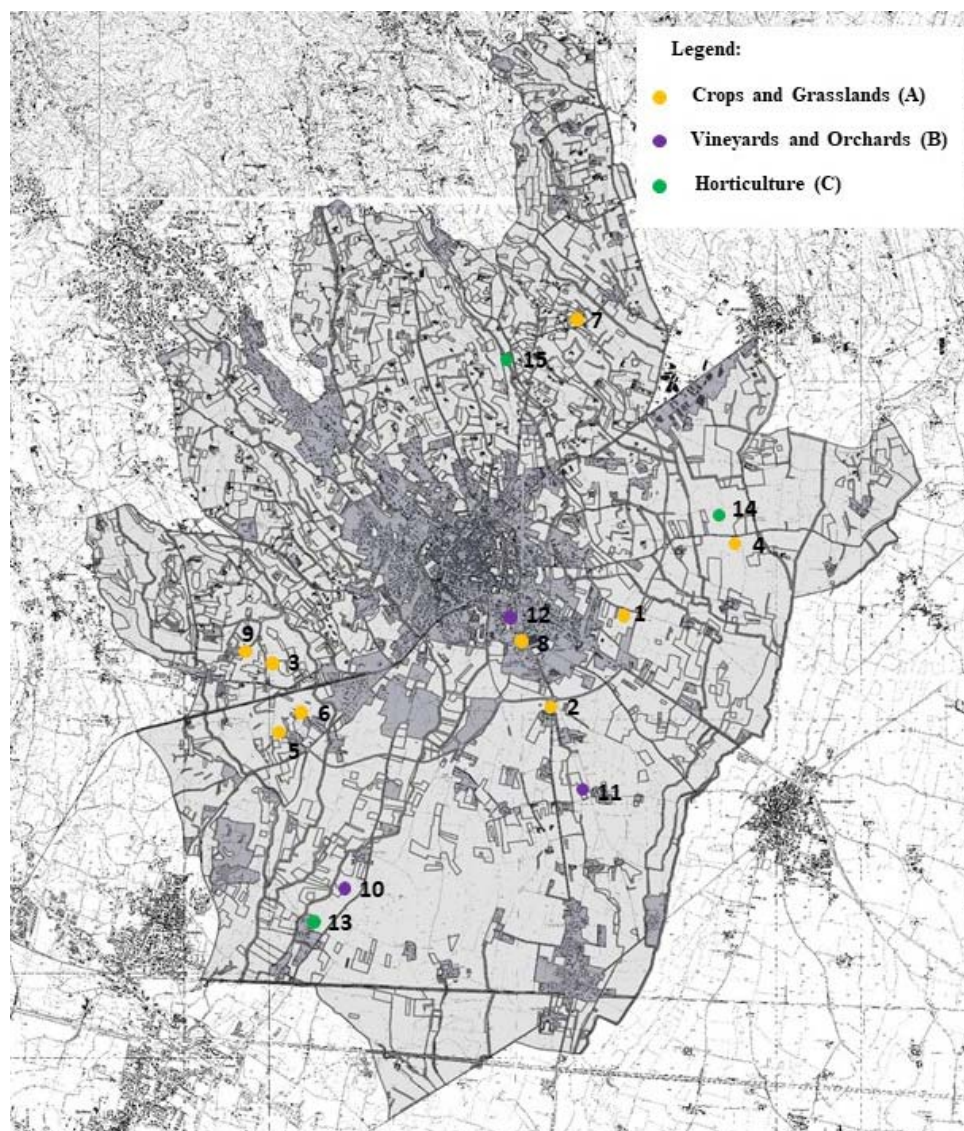


Figure 4. Location of the farms involved and their relative types within the Chieri Municipality.

During the summer 2017, face-to-face personal interviews were performed. According to different authors [32–34] the direct involvement of farmers is a fundamental step. The farmers are the direct managers and users of agroecosystems. According to Duvernoy et al. (2018) and Bohnet and Smith (2007), to ensure that the research covered the same topics in each interview, we decided to use a semistructured questionnaire [33,35]. In our study, questions were open and partially open-ended, allowing follow up prompts to discuss issues and encourage explorations of topics raised by the farmers' interviews. Each interview lasted approximately one hour. Based on the theoretical framework proposed by Xun et al. (2017) to analyze multifunctional character of peri-urban agroecosystems [36], we investigated these aspects: farm structure, production and activities and future scenarios. Table 1 shows the questionnaire used, the parameters analyzed and the assignment in farmers' interviews.

Table 1. Structure, production and activities and scenarios questions used for the farmers' interview.

	Questions	Abbreviation	Assignments (Units)
STRUCTURE	Year of constitution	Y	(Year)
	Owner gender	G	(Male, M; Female, F)
	Owner age	A	(Year)
	Level of Education	EDU	(None, 0; Elementary, 1; Middle school, 2; High school, 3; University, 4)
	Number of permanent workers	W	(Number)
	Farm type	FT	Crops and Grasslands A; Vineyards and Orchards B; Horticulture (C)
	Cultivation's methods	CM	(Traditional: 1; Integrated: 2; Organic: 3)
	Certificated product	PC	(Yes, 1; No, 0)
PRODUCTIO ACTIVITIES	Local farm selling	LS	(Yes, 1; No, 0)
	Transformation' products	TP	(Yes, 1; No, 0)
	Number of cultivations practiced	CP	(Number)
	Product type	PT	(List)
	Surface cultivated	SC	(ha)
	Soil quality practices; Types	SQP	(List)
	Water quality practices; Types	WQP	(List)
	Biodiversity quality practices; Types	BQP	(List)
SCENARIOS	Educational activities		
	Social activities	EA	(Yes, 1; No, 0)
	Communicating practices	SA	(Yes, 1; No, 0)
		MP	(Yes, 1; No, 0)
	Problems perceived; Types	PP	(List)
	Landscape awareness	LA	(Absent, 0; Low, 1; Medium, 2; High, 3)
	Role in the landscape management	LM	(Yes, 1; No, 0)
	Future changes	FC	(Yes, 1; No, 0) (List)
	Sustainability criteria	SC	(List)

3. Results

3.1. Statistical Assessment

Analyzing statistical data (ISTAT, Rome, Italy, 2010), a total of 276 farms are located in Chieri Municipality [30]. In Table 2, the average of the Utilized Agricultural Area (UAA), the owners' gender, and age were reported for each farm type. Farms A are the most numerous and the largest ones (25.17 ha) by contrast with farms B (5.50 ha) and C (6.38 ha). With reference to the farm type, the males/females pattern is different: farms A are those with more males owner (74%), followed by C (69%) and B (68%). By analyzing Table 2, we observe also that the average age of the farmers for all the farm types investigated is less than 63 (years old).

Table 2. Farm characterization types (number, mean Utilized Agricultural Area [UAA], gender of the owner and mean age).

Farm Type and Abbreviation	n°	UAA (ha)	Ownership		
			Males	Females	Age
Crops and grasslands (A)	221	25.17	164	57	54
Vineyards and orchards (B)	19	5.50	13	6	63
Horticulture (C)	36	6.38	25	11	57

In Table 3, the number of farms that satisfied multifunctional parameters (website, online selling, agritourism, didactic farms, work on behalf of third parties, nonagricultural activities, maintenance of parks and gardens, renewable energy production facilities and transformation of products) calculated for each type of farm are pointed out. We outline that farms A satisfy all the parameters except for online selling. Dividing the total number of satisfied parameters with the total number of each farms type, at the territorial level, the farms C (50%) and the farms B (21%) contribute more to increase the multifunctionality compared to the farms A (11%).

Table 3. Multifunctional parameters and associated number of farms in Chieri Municipality (Agriculture Census, ISTAT, Rome, Italy, 2010).

Multifunctional Parameters	Farm Types (Number)		
	A (221)	B (19)	C (36)
Website	3	-	3
Online selling	-	-	2
Agritourism	2	1	-
Didactic farms	2	1	-
Work on behalf of third parties—non-agricultural activities	4	-	1
Maintenance of parks and gardens	3	-	11
Renewable energy production facilities	6	1	-
Transformation of products	4	1	1
Total of satisfied parameters/Number of farms (%)	11%	21%	50%

3.2. Qualitative Assessment

The farms' structure results are reported in Table 4 (the assignments reported before in Table 1 are reported in this Table). Through the analyses of interviews' data, several interesting points in the data emerged. Firstly, with the respect to the year of constitution (Y), most of the farms (46%) were constituted between 1970–2000; secondly (33%), between 2000 and 2018 and thirdly (21%) before 1970. Concerning owner gender (G), women represent 33.3% of the total number of owners farmers investigated. By observing the owners' mean age (A), we noted that most of the interviewees (80%) were young and middle-aged adults (range of 30–60 years old). The highest level of education (EDU) attained was generally middle school. Indeed 53.3% had a middle school education, 40% high school, and 6.7% elementary. Analyzing the number of workers (W), we note that their activity is mainly family-owned, and only 26.7% farmers have more than four permanent workers. Concerning farming type (FT), the 60% are crops and grasslands (A), 20% vineyards, woodlands and orchards (B), and 20% horticulture farms (C). Regarding cultivation's methods (CM), the majority of farmers (73%) practiced a traditional-conventional agriculture; (20%) practiced integrated methods, and only 7% applied organic systems. Despite the different kind of cultivation methods, some farms (46%) had certificated products. Some of their products are certificated because they are typical and some are niche products. The 90% of farmers interviewed sell their products in the farm or in the markets of neighboring municipalities (LS) and only the 30% transform agricultural and livestock products directly on site (TP).

Table 4. Farm structure.

ID	Y	G	A	EDU *	W	FT **	CM ***	PC	LS	TP
1	1987	M	61	2	2	A	1	0	1	0
2	1996	M	52	2	2	A	1	0	1	0
3	2002	M	43	3	2	A	1	1	0	0
4	1996	M	49	2	3	A	1	1	1	0
5	1970	M	39	3	2	A	1	1	0	0
6	1950	M	53	2	2	A	1	0	0	0
7	1987	M	53	2	3	A	1	1	0	0
8	2003	M	32	3	2	A	1	1	1	0
9	1997	M	58	2	6	A	2	1	1	1
10	1995	F	65	2	2	B	2	0	1	1
11	1994	F	54	3	4	B	3	0	1	0
12	2003	M	42	3	2	B	2	1	1	1
13	2004	F	45	3	4	C	1	0	1	0
14	1968	M	70	2	5	C	1	0	1	0
15	2011	M	49	1	1	C	1	0	0	0

* EDU- None, 0; Elementary, 1; Middle school, 2; High school, 3; University, 4. ** FT- Crops and Grasslands, A; Vineyards, Woodlands and Orchards, B; Horticulture, C. *** CM- Traditional, 1; Integrated, 2; Organic, 3.

With the aim to evaluate production and activities, farmer's results are reported in Table 5. Firstly, as far as the production is concerned, we observed that several cultivations are practiced (CP), ranging between one and 20. Mainly, the farms characterized by mixed productions (vegetables-fruits, vegetable-flowers and wine-fruits) have more than nine types of cultivations. These features contribute to characterize the heterogeneity of Chieri Municipality's landscape. Moreover, we outlined that different products type (PT) characterized the investigated farms. In particular, mainly meat (33.3%), milk (26.7%), flowers (13.3%), honey (6.7%) and other mixed productions (20%) are produced. The analyzed farms have an average extension of 31 ha. There are significant differences in farm sizes. In particular, the cereal farms linked to meat production are the largest (>30 ha), while the floriculture and horticulture farms are less extensive (≤ 3 ha).

With respect to the farms' activities, different parameters were identified. Specifically, the farmers with their practices contribute indirectly to improve soil, water and biodiversity quality. We can note that all farmers applied different soil quality practices (SQP). In particular, the use of manure (25%), crop rotation (25%), mulching (19%) and tillage conservation (16%) are the most shared practices. By contrast, greening (9%), intercropping (3%) and the use of green manure (3%) are practices applied mainly by the organic farm. Related to water quality, the farmers applied different common practices (WQS). Firstly, the rainwater harvesting (46.7%) is the most practice used and secondly the irrigation system characterized by a low flow system (33.3%). By contrast, few biodiversity quality practices (BQP) are applied by the investigated farmers. Permanent grassland (46.7%), and hedgerows and tree lines (40%) are the most common practices. Moreover, the farmers that produce milk and meat used permeant grasslands. To analyze the multifunctionality, other farm's activities not directly linked to production were investigated. As far as the educational activities (EA) are concerned, some farms (33%) are educational farms and only one is involved in social actions (SA). With respect to communication and marketing practices (MP), some farms (40%) use different social networks (web or Facebook) to promote their products. We have also analyzed farmers' landscape awareness (LA). The majority of the farmers (67%) had a high landscape awareness of their rural landscape, followed (33%) having a medium awareness.

With the aim to evaluate future scenarios, farmer's results are reported in Table 6 (the assignments reported before in Table 1 are reported in this Table). The first aspect investigated was related to the problems perceived (PP) by the farmers. We can observe that all the farmers perceived different kind of problems. The primary is the lack of food quality awareness from consumers (33%), secondly correlated to farming activity is the lack of generational turnover (27%). Other problems perceived are the farmers' income decreasing (20%) and the bureaucracy (20%) that negatively contribute to peri-urban farming activity. Regarding landscape management (LM), almost all (80%) considered their activity playing an important role in that respect. Regarding their future, 60% of the farmers have foreseen future changes (FC) mainly related to the improvement environmental and production sustainability. All the farmers had different idea about the improvement of their activity over time. With respect to this topic, they have proposed sustainability criteria (SC). In particular: supporting educational and didactic programs (53%) and developing integrated farming with the introduction of new cultivations and more suitable practices (47%) are considered the main strategies. For the farmers, promoting new communication and new marketing strategies (27%), valorizing the primary and secondary products also with the their transformation (20%), improving rural farm networks and cooperation (20%), and direct farm selling (20%) and increasing the tourism activity (13%) are considered sustainable actions for ensuring peri-urban farming.

Table 5. Production and activities questions.

ID	CP (n)	PT	SC (ha)	SQP	WQP	BQP	EA *	SA *	MP *
1	3	Milk	65.00	Manure using, Conservation tillage	Rainwater harvesting		0	0	0
2	8	Meat	60.00	Manure using, Conservation tillage	Irrigation system, Rainwater harvesting	Hedgerows and tree-lines, Permanent grassland	0	0	0
3	6	Meat	30.00	Greening, Mulching, Manure using, Crop rotation	Irrigation system, Rainwater harvesting	Hedgerows and tree-lines, Permanent grassland	0	0	0
4	5	Meat	77.00	Manure using, Crop rotation	Irrigation system, Rainwater harvesting	Permanent grassland	0	0	0
5	5	Milk	40.00	Manure using, Crop rotation	Rainwater harvesting	Permanent grassland	0	0	0
6	3	Milk	35.00	Manure using, Crop rotation	Rainwater harvesting	Permanent grassland	0	0	0
7	4	Meat	75.00	Manure using, Crop rotation	Fishponds	Hedgerows and tree-lines	0	0	0
8	3	Meat	5.00	Mulching Conservation tillage Crop rotation	Rainwater harvesting	Hedgerows and tree-lines	0	0	1
9	1	Milk	40.00	Mulching	Fishponds	Permanent grassland	1	0	1
10	1	Honey	1.50	-	Without irrigation system	Permanent grassland	1	0	1
11	20	Vegetables Fruits	2.80	Greening, Manure using, Conservation tillage, Crop rotation, Intercropping, Green manure using	Irrigation system	Hedgerows and tree-lines	0	0	1
12	9	Wine Fruits	34.00	Greening Conservation tillage Crop rotation	Without irrigation system	Hedgerows and tree-lines	1	0	1
13	2	Flowers	1.20	Mulching	Irrigation system		1	1	0
14	2	Flowers	2.00	Mulching	Irrigation system, Fishponds		1	0	1
15	14	Vegetables Flowers	0.20	Mulching	Without irrigation system		0	0	0

* EA-SA-MP (Yes, 1; No, 0).

Table 6. Farmers' scenarios.

ID	PP	LA *	LM **	FC **	SC
1	Farmer's income	2	1	1	Promoting communication strategies Improving rural farm networks Increasing farmers' cooperation
2	Too much bureaucracy	3	1	1	Introducing new practices more suitable Developing integrated farming
3	Too much bureaucracy Climate change	3	1	1	Developing integrated farming and practices Increasing farmers' cooperation
4	Too much bureaucracy	2	1	1	Improving direct farm selling Promoting communication strategies Supporting educational programs in farm Introducing new practices more suitable
5	Lack of food quality awareness	3	1	1	Introducing new practices more suitable
6	Farmer's income	2	1	0	Valorizing the primary products
7	Lack of generational turnover	3	1	1	Supporting educational programs in farm Introducing new cultivations more suitable Increasing the tourism activity Improving rural farm networks
8	Lack of food quality awareness	3	1	1	Supporting educational programs in farm Turning didactic farm
9	Lack of food quality awareness	3	1	0	Supporting educational programs in farm Valorizing the primary and secondary products
10	Climate change Entomological diseases	3	1	0	Improving direct farm selling Supporting educational programs in farm
11	Lack of generational turnover	2	1	0	Promoting food organic chain Transforming products in farm
12	Lack of food quality awareness	2	1	1	Increasing the tourism activity Improving rural farm networks Supporting educational programs in farm
13	Lack of food quality awareness	3	0	0	Promoting new marketing strategy Improving farm selling
14	Farmer's income Lack of food quality awareness	3	0	1	Promoting communication strategies Supporting educational programs in farm
15	Lack of generational turnover	3	0	0	Improving direct farm selling

* LA (Absent, 0; Low, 1; Medium, 2; High, 3); ** LM-FC (Yes, 1; No, 0).

4. Discussion

4.1. How is Multifunctionality Applied in Peri-Urban Agroecosystems

To analyze how multifunctionality is applied at the landscape level, statistical assessment provides important information. Although the problems perceived by the farmers interviewed, analyzing their average age (less than 65 years old), we could assume that the rural identity of the area will be stable for at least next 10 years. Also with their new ideas, young farmers could increase the multifunctional approach in the farm. Although farms in peri-urban areas often do not have large dimensions, it must be taken into account that appropriate technical, marketing and structural investment strategies can make sustainability possible for farmers despite the constraint of the small scale [37]. These strategies can also be linked to the use of social media and websites for the promotion of activities. In Table 3 it is possible to notice how only horticultural farms (C) sell their products online, while none of the orchard farms (B) have a website. These data are confirmed in our interviews.

However, the economic aspect linked to the production is not the only parameter to be taken into consideration. The creation of social bonds between the inhabitants, educational and social activities are needed. Also in Table 3 it is possible to notice how only farms A and B have didactic/recreational activities, albeit in limited numbers, as agritourism and didactic farms. This result is in contrast to

the European trend. Moreover, it is also highlighted the growth of farm diversification across Europe, including nature and landscape management [19,37]. At the peri-urban level, the management of green areas such as parks and gardens turns out to be a qualifying activity. It is also possible to notice how farms (C) are the most inclined to assist in the maintenance of public parks and gardens, while farms B do not contribute to this service. There is the need to identify for each types of farm the possibility to satisfy more parameters and to increase even more the multifunctionality of the territory. This result can be achieved by increasing the dialogue between farmers and municipal officials. However, multifunctional conservation and development of agriculture in the peri-urban area requires a wide range of policy and planning measures [38]. Regarding the role of Chieri local government, no financial supports for peri-urban farmers has been provided yet. Nevertheless new eco touristic programs are going to be realized including farms in green and cultural networks.

To analyze how multifunctionality is applied at farm level, the analysis of the interview results allowed us to characterize the farm's structure and to analyze production and activities. Our study shows that all the farmers investigated characterize a specific peri-urban agroecosystem, linked to land uses and cultivations practiced. All the farms supply food and provide different kind of products to the community. Thinking of multifunctionality as the integration of different functions and activities that produce beneficial effects on local economy, environment and social objectives, it is possible to outline some differences between the different farm types identified (A, B, C). These farm types are characterized by different structures, functions and activities, correlated to the multifunctionality concept. Indeed, the multifunctional system, the diverse and typical agricultural products, the production of high-quality food, the transformation processes of these products, and direct sales can be regarded as having the most important potential for Chieri Municipality. These elements can be considered as economically and socially beneficial and as constituting a win-win scenario in the global market.

With their agricultural practices and land management, peri-urban farmers produce positive effects. Indeed, they contribute to improve soil, water and biodiversity quality in different ways. Regarding soil quality, crops and grasslands farmers (A) mainly use manure and crop rotation as common practices, vineyards and orchards farmers (B) adopt other different practices, such as greening and intercropping, and horticultural farmers (C) adopt only mulching. These features are mainly linked to farm types, structure and agricultural management. As far as the water quality is concerned, all A farmers applied different irrigation' systems for their cultivations, by contrast to B and C. With respect to the biodiversity quality, hedgerows and tree-lines and permanent grassland are the most common agricultural practices adopted by A and B farms.

Concerning the other activities, few peri-urban farmers support educational and social activities and apply communicating practices. We noticed that some B and C farms are also educational and social farms. These results are confirmed also by statistical assessment (municipality level). Moreover, peri-urban farmers with their current management do not provide only private good-types commodities, but also a broad range of public good-types services. According to Ohe (2007) and Zasada et al. (2011), if farmers can successfully take an externality into the farm business or internalize it, multifunctionality will give them a chance to realize a "new" income source [15,39]. Interviewed farmers outlined their income as a perceived problem. In this perspective, they considered that promoting communication strategies, improving farm networks and cooperation could be the best sustainability criteria.

4.2. How to Ensure the Sustainability in Peri-Urban Agroecosystem?

To analyze how to ensure the sustainability in peri-urban agroecosystem, the analysis of interview results allowed us to identify the future scenarios perceived by Chieri farmers. With their activities, they supply local food and provide an important benefits for the community and almost all A and B farmers considered their important role in landscape management. By contrast, C farmers do not consider their activity as beneficial for the landscape management. With respect to these results,

we think that the horticulture farms investigated (C) are very small and equipped with specific structures as greenhouses for horticultural cultivations (flowers and vegetables), and that affects their opinions. Moreover, A, B, C farmers have a high–medium awareness of Chieri landscape. In this study, the 15 peri-urban farmers analyzed could increase the diversification of farming activities, providing multiple public services, most of all cultural services. Decisions on agricultural practices are typically made at farm level by contrast to other practices applied unawares by farmers. The farmers interviewed recognize that their activities can positively or negatively affect the health of ecosystems and it is therefore important to provide them with the right information to be able to improve this, so that it can benefit all the population can benefit.

With respect to the current problems (PP), all the farmers perceived different critical issues. The lack of food quality awareness and the lack of generational turnover are common problems for the three farm types identified. Regarding future changes, the farmers have different opinions; in particular A farms (89%) plan to make changes in the future, by contrast to B (33.3%) and C (33.3%). Despite the conflicting views on future changes, all the farmers identified sustainability criteria to ensure the sustainability in peri-urban agroecosystems. In this context, UNESCO rural sites are continually subjected to socioeconomic pressures. For these sites, the UNESCO Committee outlined the necessity to guarantee the monitoring processes and the sustainability of the management system. The MAB programme contributes to a greater involvement of human and natural science in policy planning and development, but no models, rules, or specific definitions have been provided for this purpose. After the inclusion in the UNESCO MAB List, the site must be properly managed in order to maintain the outstanding values. In this perspective, UNESCO is just the supervisor and has no role in the site's management.

Examining UNESCO Management Plans, Gullino et al. (2015) identified the best practices, strategies, actions and measures applied for the conservation of their universal values with particular focus on sustainability [29]. UNESCO identified the main strategies to achieve sustainability: developing participatory approach, valorizing the primary and secondary products, increasing the tourism activity and culture, promoting education and communication, improving food quality, developing economic strategies to improve the food quality and controlling the origin denomination. Some of them are the same identified by peri-urban farmers investigated in this study.

4.3. How Could a Bottom-up Approach Promote Sustainable Actions, Strategies and Policies?

As explained by Mauchline et al. (2012) and Douwe (2003), using participatory approach, there is considerable synergy in rural development practices and processes [40,41]. This synergy is created through the development of multifunctionality at farm level and the development of new institutional programs that involve cooperation and the network of the other activities of the farmers, not only related to food production. Comparing statistical and qualitative assessments we have shown that rural development processes based on multifunctionality concept are applied both at municipality and farm scale (Figure 5). In particular, in statistical assessment, the multifunctionality expressed at municipality scale with different parameters can be applied in different directions. Moreover, in qualitative assessment, the sustainability criteria, classified in economic, environmental and social criteria, are sustainable actions strategies and policies perceived by the peri-urban farmers investigated. Farmers' income, primary and secondary products valorization, direct farm selling and new marketing and communication strategies are the main economic criteria identified. With respect to the farmers, agroecosystem quality, soil fertility, water and biodiversity quality and the introduction integration of new cultivations and practices more suitable are the main environmental criteria recognized. Citizens' well-being, rural farm networking and tourism, educational and didactic programs supporting and didactic farms turning are considered instead main social criteria.

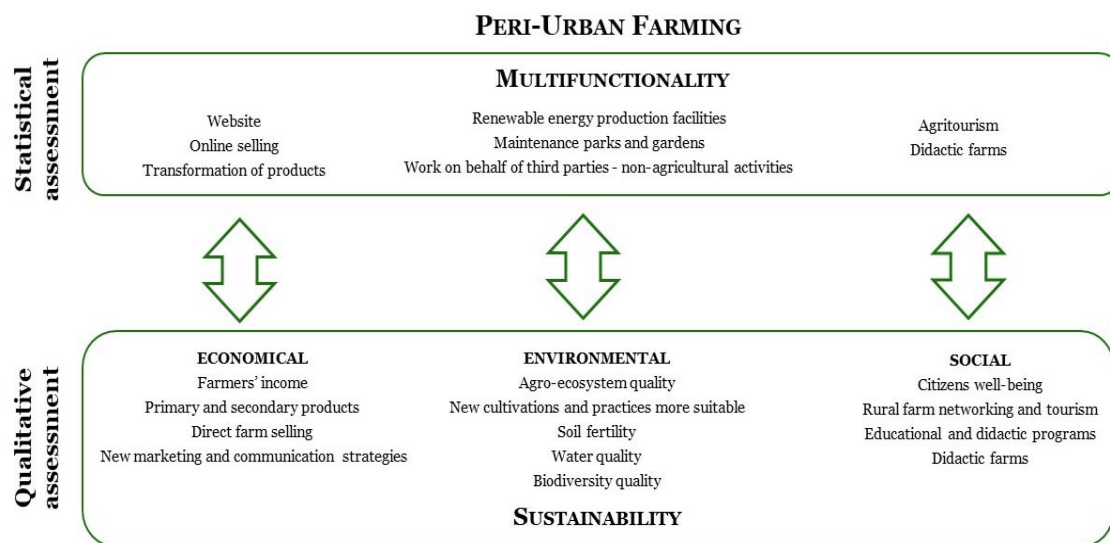


Figure 5. Linking sustainability and multifunctionality in peri-urban farming.

For different authors, assessing landscape multifunctionality is crucial for land management and planning [18,19,41,42]. In our research, we analyzed multifunctional propensity using municipality and farm levels. The multifunctional attitude was applied in different ways with references to the farm types. In particular, B and C farmers, with their activity produce more beneficial effects on local economy, environment and social objectives than A.

By using a participatory approach, Souldard et al., 2017 analyzed nine European case study areas and the role of economic actors, ecosystem services, socioeconomic benefits and regional competitiveness in different agricultural landscape systems. Agricultural food production was perceived by stakeholders as a major element to create value from landscape, but nonmarketable products. Ecological, environmental and landscape ecosystem services linked to food production were considered positive strategies for sustainability [7]. In this study, data were used in an alternative way, analyzing in depth all those aspects potentially related to the agricultural activity, but which are not the core business of the farm. Some parameters were chosen in order to understand which farms were more likely to be multifunctional, hoping to understand if this propensity was linked to cultural factors or to the availability of agricultural structures and equipment. We were surprised to notice that some farms would be immediately willing to diversify their economic incomes, bringing benefits to the environment and to the community. By contrast to the European trend, few peri-urban farms in our study had adopted a multifunctional character. In this perspective, Soulard et al. (2017) outlined that in recent years, new multifunctional farming systems emerged but the governance of the interaction between environmental issues and local food supply is still under construction [7].

According to different authors, increasing the interest for educational and social activities and for ecotourism and alternative food networks should be considered opportunities for farms also even if they do not necessarily increase their rural economy directly [2–4,42]. Concerning our study, focusing on local food demand and on the lack of awareness of food quality perceived, the exploitation of the proximity to the urban-based consumers, demanding of high-value and suitable products, represent for the direct transforming of these primary products and the direct selling, opportunities for peri-urban farmers. In fact, the proximity to urban areas linked to urban demand for multiple functions and services, for example, quality food, natural elements, rural network, didactic and recreation spaces represent important incentives to peri-urban farmers to carry out new activities beyond commodity production. In this context, landscape-labelling approach should be considered as an opportunity for farmers and a challenge for integrated landscape planning and management in peri-urban areas [43].

5. Conclusions

According to Duvernoy et al. (2018), discontinuous urbanization has recently transformed peri-agricultural areas into mixed spaces characterized by landscape fragmentation [33]. Ensuring the sustainable development of those areas is the priority. In this context, the analysis of the multifunctional character and development perspectives of peri-urban agroecosystems represents the central topic of this applied research.

In the case of Chieri, exportable to other European peri-urban sites, we promoted the adoption of a methodology based on the integration of quantitative and qualitative analysis. We have investigated the peri-urban agroecosystem and opportunities perceived by farmers and their multifunctional adaptation behavior with particular reference to different farm types. Such tools, as indicated by Wu et al. (2017) and Ives and Kendal (2013), should include government incentives to promote those goods that have no market, such as biodiversity conservation or the aesthetic enhancement of the rural landscape [44,45]. In addition to the valuable work done by farmers in land management, planning tools are needed to encourage multifunctional land use and the diversification of the rural economy.

According to the different farm types identified, the multifunctionality assumes different aspects covering specific sets of sustainability needs. We consider it important to move from farm-level multifunctionality to landscape-level multifunctionality in order to provide all services at a territorial scale. In analyzing statistical and qualitative assessment for addressing peri-urban farming, we propose the following strategies: increasing rural farm networks and cooperation (territorial scale), promoting initiatives for valorizing the local food products, including farms in touristic and cultural networks, and involve farmers in social and didactic programs in collaboration with associations, schools, and public bodies. In conclusion, we believe that the information obtained are useful at the political level in order to manage the whole territory in a sustainable development perspective. This methodology could be applied for decision makers and planners for implementing a participatory approach in environmental-social and economic programs for peri-urban areas.

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